

REMARKS

Claim Rejections under 35 U.S.C. § 103 (a)

Claims 1-7 and 16-20

The Examiner has rejected claims 1-7 and 16-20 under 35 U.S.C. § 103 (a) as being unpatentable over Okamoto et al. (U.S. Patent 4,517,280) in view of Nakao (U.S. 2003/0091940 A1).

Claims 1-7

Applicant respectfully disagrees. Applicant has amended claim 1. Support is provided in the specification including at paragraphs [0065], [0066], and [0068].

Claim 1, as amended, of Applicant's claimed invention claims a method comprising: providing a substrate (205, 210); forming an array in a first photoresist layer (215, 220) over the substrate with a high resolution system wherein the array comprises repeating parallel lines (305, 505) and spaces (310); forming arbitrarily-shaped features (705, 710, 715, 720) in a second photoresist layer (605) above the array with a low resolution system, wherein the arbitrarily-shaped features overlap some of the lines and spaces in the array; etching the substrate through portions of the array not covered by the arbitrarily-shaped features; reducing continuity of the

lines and spaces overlapped by the arbitrarily shaped features; and introducing irregularity into the array. See Figures 3-10.

Okamoto et al. teaches a process for making a diffraction grating (15) having a period and a direction in an area of a substrate (1). See Figures 3(1)-3(6).

Nakao teaches providing a design pattern having various dimensions on a photomask (Figure 26A) and extracting fine bright line patterns (3A1) as opening patterns that have original size as mask pattern 1 on a first photomask 5A (Figure 26B) and extracting remaining large patterns (3A2) as opening patterns that have been oversized as mask pattern 2 on a second photomask 5B (Figure 26C).

However, Okamoto et al. does not teach introducing irregularity into the array. Furthermore, Nakao does not teach some overlap between mask pattern 1 and mask pattern 2.

Thus, a combination of the methods of Okamoto et al. and Nakao, even if possible, would not produce the method of Applicant's claimed invention, as claimed in claim 1 at the time the invention was made.

Claims 2-7 are dependent on claim 1, as amended. Thus, a combination of the methods of Okamoto et al. and Nakao, even if possible, would also not produce the method of Applicant's claimed invention, as claimed in claims 2-7 at the time the invention was made.

In view of the foregoing, Applicant respectfully requests the Examiner to withdraw the rejections under 35 U.S.C. § 103 (a) to claims 1-7.

Claims 16-20

Applicant respectfully disagrees with the Examiner. Applicant has amended claim 16. Support is provided in the specification including at paragraph [0042].

Claim 16, as amended, of Applicant's claimed invention claims a method comprising: interfering a pair of collimated laser beams to illuminate a first photoresist layer (215, 220) on a substrate (205, 210); forming periodic lines (305, 505) and spaces (310); forming arbitrarily-shaped features (705, 710, 715, 720) in a second photoresist layer (605) above the periodic lines and spaces, wherein the arbitrarily-shaped features shield portions of the periodic lines and spaces; forming trenches (1005) in the substrate below the portions of the lines not shielded by the arbitrarily-shaped features; eliminating continuity of the lines that are shielded by the arbitrarily-shaped features; and introducing irregularity into the periodic lines and spaces. See Figures 3-10.

Okamoto et al. teaches a process for making a diffraction grating (15) having a period and a direction in an area of a substrate (1). See Figures 3(1)-3(6).

Nakao teaches providing a design pattern having various dimensions on a photomask (Figure 26A) and extracting fine bright line patterns (3A1) as opening patterns that have original size as mask pattern 1 on a first photomask 5A (Figure 26B) and extracting remaining large patterns (3A2) as opening patterns that have been oversized as mask pattern 2 on a second photomask 5B (Figure 26C).

However, Okamoto et al. does not teach introducing irregularity into the array. Furthermore, Nakao does not teach some overlap between mask pattern 1 and mask pattern 2.

Thus, a combination of the methods of Okamoto et al. and Nakao, even if possible, would not produce the method of Applicant's claimed invention, as claimed in claim 16 at the time the invention was made.

Claims 17-20 are dependent on claim 16, as amended. Thus, a combination of the methods of Okamoto et al. and Nakao, even if possible, would also not produce the method of Applicant's claimed invention, as claimed in claims 17-20 at the time the invention was made.

In view of the foregoing, Applicant respectfully requests the Examiner to withdraw the rejections under 35 U.S.C. § 103 (a) to claims 16-20.

Claim Rejections under 35 U.S.C. § 103 (a)

Claims 8 and 21

The Examiner has rejected claim 8 and 21 under 35 U.S.C. § 103 (a) as being unpatentable over Okamoto et al. (U.S. Patent 4,517,280) in view of Nakao (U.S. Patent Application Publication 2003/0091940 A1), as applied to claims 1-7 and 16-20 above, and further in view of Sugita et al. (EP 0915384)..

Claim 8

Applicant respectfully disagrees with the Examiner. Claim 8 is dependent on claim 1. Applicant has amended claim 1. Support is provided in the specification including at paragraphs [0065], [0066], and [0068].

Claim 1, as amended, of Applicant's claimed invention claims a method comprising: providing a substrate (205, 210); forming an array in a first photoresist layer (215, 220) over the substrate with a high resolution system wherein the array comprises repeating parallel lines (305, 505) and spaces (310); forming arbitrarily-shaped features (705, 710, 715, 720) in a second photoresist layer (605) above the

array with a low resolution system, wherein the arbitrarily-shaped features overlap some of the lines and spaces in the array; etching the substrate through portions of the array not covered by the arbitrarily-shaped features; reducing continuity of the lines and spaces overlapped by the arbitrarily shaped features; and introducing irregularity into the array. See Figures 3-10.

Okamoto et al. teaches a process for making a diffraction grating (15) having a period and a direction in an area of a substrate (1). See Figures 3(1)-3(6).

Nakao teaches providing a design pattern having various dimensions on a photomask (Figure 26A) and extracting fine bright line patterns (3A1) as opening patterns that have original size as mask pattern 1 on a first photomask 5A (Figure 26B) and extracting remaining large patterns (3A2) as opening patterns that have been oversized as mask pattern 2 on a second photomask 5B (Figure 26C).

Sugita et al. teaches using a k_1 factor of less than 0.4, such as 0.25, in an interference exposure process. See Col.4, lines 1-41.

However, Okamoto et al. does not teach introducing irregularity into the array. Furthermore, Nakao does not teach some overlap between mask pattern 1 and mask pattern 2.

Thus, a combination of the methods of Okamoto et al., Nakao, and Sugita et al., even if possible, would not produce the method of Applicant's claimed invention, as claimed in claim 1 at the time the invention was made.

Claim 8 is dependent on claim 1, as amended. Thus, a combination of the methods of Okamoto et al., Nakao, and Sugita et al., even if possible, would also not produce the method of Applicant's claimed invention, as claimed in claim 8 at the time the invention was made.

In view of the foregoing, Applicant respectfully requests the Examiner to withdraw the rejections under 35 U.S.C. § 103 (a) to claim 8.

Claim 21

Applicant respectfully disagrees with the Examiner. Claim 21 is dependent on claim 16. Applicant has amended claim 16. Support is provided in the specification including at paragraph [0042].

Claim 16, as amended, of Applicant's claimed invention claims a method comprising: interfering a pair of collimated laser beams to illuminate a first photoresist layer (215, 220) on a substrate (205, 210); forming periodic lines (305, 505) and spaces (310); forming arbitrarily-shaped features (705, 710, 715, 720) in a second photoresist layer (605) above the periodic lines and spaces, wherein the arbitrarily-shaped features shield portions of the periodic lines and spaces; forming trenches (1005) in the substrate below the portions of the lines not shielded by the arbitrarily-shaped features; eliminating continuity of the lines that are shielded by the arbitrarily-shaped features; and introducing irregularity into the periodic lines and spaces. See Figures 3-10.

Okamoto et al. teaches a process for making a diffraction grating (15) having a period and a direction in an area of a substrate (1). See Figures 3(1)-3(6).

Nakao teaches providing a design pattern having various dimensions on a photomask (Figure 26A) and extracting fine bright line patterns (3A1) as opening patterns that have original size as mask pattern 1 on a first photomask 5A (Figure 26B) and extracting remaining large patterns (3A2) as opening patterns that have been oversized as mask pattern 2 on a second photomask 5B (Figure 26C).

Sugita et al. teaches using a k_1 factor of less than 0.4, such as 0.25, in an interference exposure process. See Col.4, lines 1-41.

However, Okamoto et al. does not teach introducing irregularity into the array. Furthermore, Nakao does not teach some overlap between mask pattern 1 and mask pattern 2.

Thus, a combination of the methods of Okamoto et al., Nakao, and Sugita et al., even if possible, would not produce the method of Applicant's claimed invention, as claimed in claim 16 at the time the invention was made.

Claim 21 is dependent on claim 16, as amended. Thus, a combination of the methods of Okamoto et al., Nakao, and Sugita et al., even if possible, would also not produce the method of Applicant's claimed invention, as claimed in claim 21 at the time the invention was made.

In view of the foregoing, Applicant respectfully requests the Examiner to withdraw the rejections under 35 U.S.C. § 103 (a) to claim 21.

Claim Rejections under 35 U.S.C. § 103 (a)

Claims 22-28 and 37

The Examiner has rejected claims 22-28 and 37 under 35 U.S.C. § 103 (a) as being unpatentable over Okamoto et al. (U.S. Patent 4,517,280) in view of Nakao (U.S. Patent Application Publication 2003/0091940 A1) and Sugita et al. (EP 0915384)..

Claims 22-28

Applicant respectfully disagrees with the Examiner. Claims 23-28 are dependent on claim 22. Applicant has amended claim 22. Support is provided in the specification including at paragraphs [0030] and [0065].

Claim 22 as amended, of Applicants' claimed invention claims a method comprising: patterning a first layer (215, 220) on a substrate (205, 210) using a first lithographic technique, the patterning providing alternating lines (305, 505) and spaces (310) in the first layer with a first pitch (325) yielding a first k_1 factor smaller than or equal to 0.5; printing, in a photoresist layer (605) using a second lithographic technique providing a second pitch (730), a first feature (710) to overlap a first collection of one or more of the repeating lines and spaces at a first longitudinal position, a second feature (715) to overlap a second collection of one or more of the repeating lines and spaces at a second longitudinal position, and a third feature (720) to overlap a third collection of one or more of the repeating lines and spaces at a third longitudinal position, wherein the first feature, the second feature, and the third feature are noncontiguous and wherein the second pitch (730) is two or more times larger than the first pitch (325); and etching the substrate to transfer, to the substrate, a superposition of the lines and spaces with the first feature, the second feature, and the third feature, wherein the continuity of at least the first collection, the second collection, and the third collection is broken in the transferred superposition. See Figures 3-10.

Okamoto et al. teaches a process for making a diffraction grating (15) having a period and a direction in an area of a substrate (1). See Figures 3(1)-3(6).

Nakao teaches providing a design pattern having various dimensions on a photomask (Figure 26A) and extracting fine bright line patterns (3A1) as opening patterns that have original size as mask pattern 1 on a first photomask 5A (Figure

26B) and extracting remaining large patterns (3A2) as opening patterns that have been oversized as mask pattern 2 on a second photomask 5B (Figure 26C).

Sugita et al. teaches using a k_1 factor of less than 0.4, such as 0.25, in an interference exposure process. See Col.4, lines 1-41.

However, Okamoto et al. does not teach introducing irregularity into the array. Furthermore, Nakao does not teach some overlap between mask pattern 1 and mask pattern 2.

Thus, a combination of the methods of Okamoto et al., Nakao, and Sugita et al., even if possible, would not produce the method of Applicant's claimed invention, as claimed in claim 22 at the time the invention was made.

Claims 23-28 are dependent on claim 22, as amended. Thus, a combination of the methods of Okamoto et al., Nakao, and Sugita et al., even if possible, would also not produce the method of Applicant's claimed invention, as claimed in claims 23-28 at the time the invention was made.

In view of the foregoing, Applicant respectfully requests the Examiner to withdraw the rejections under 35 U.S.C. § 103 (a) to claims 22-28.

Claim 37

Applicant respectfully disagrees with the Examiner. Applicant has amended claim 37. Support is provided in the specification including at paragraphs [0042] and [0065].

Claim 37 as amended, of Applicant's claimed invention claims method comprising: patterning a first layer (215, 220) of photoresist on a substrate (205, 210) using interference lithography to provide a collection of periodic lines (305, 505) and spaces (310) having a first pitch; patterning a second layer (605) of photoresist using

a second lithographic technique to provide an arbitrary feature with a second pitch, wherein the second pitch is two or more times larger than the first pitch and wherein the arbitrary figure comprises a first feature (710) and a second feature (715) that are noncontiguous and that each overlaps one or more of the periodic lines and spaces at different longitudinal positions; and etching the substrate to transfer a superposition of the lines and spaces provided by patterning the first layer and the arbitrary feature provided by patterning the second layer to the substrate, wherein the continuity of at least one of the lines and spaces is broken at the different longitudinal positions in the transferred superposition. See Figures 3-10.

Okamoto et al. teaches a process for making a diffraction grating (15) having a period and a direction in an area of a substrate (1). See Figures 3(1)-3(6).

Nakao teaches providing a design pattern having various dimensions on a photomask (Figure 26A) and extracting fine bright line patterns (3A1) as opening patterns that have original size as mask pattern 1 on a first photomask 5A (Figure 26B) and extracting remaining large patterns (3A2) as opening patterns that have been oversized as mask pattern 2 on a second photomask 5B (Figure 26C).

Sugita et al. teaches using a k_1 factor of less than 0.4, such as 0.25, in an interference exposure process. See Col.4, lines 1-41.

However, Okamoto et al. does not teach introducing irregularity into the array. Furthermore, Nakao does not teach some overlap between mask pattern 1 and mask pattern 2.

Thus, a combination of the methods of Okamoto et al., Nakao, and Sugita et al., even if possible, would not produce the method of Applicant's claimed invention, as claimed in claim 37 at the time the invention was made.

In view of the foregoing, Applicant respectfully requests the Examiner to withdraw the rejections under 35 U.S.C. § 103 (a) to claim 37.

Conclusion

Applicant believes that all claims pending, including claims 1-2, 16-28, and 37, are now in condition for allowance so such action is earnestly solicited at the earliest possible date.

Pursuant to 37 C.F.R. § 1.136 (a) (3), Applicant hereby requests and authorizes the U.S. Patent and Trademark Office to treat any concurrent or future reply that requires a petition for extension of time as incorporating a petition for extension of time for the appropriate length of time.

Should there be any additional charge or fee, including extension of time fees and fees under 37 C.F.R. § 1.16 and § 1.17, please charge Deposit Account No. 50-0221.

If a telephone interview would in any way expedite the prosecution of this application, the Examiner is invited to contact the undersigned at (408) 653-7897.

Respectfully submitted,
INTEL CORPORATION

Dated: ____August 18____, 2008

____/George Chen/____

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